PIBS #2121

RESIDENTIAL AIR CONDITIONING DEVICES

PUBLICATION NPC-216

1993

MINISTRY OF ENVIRONMENT AND ENERGY

This Publication establishes sound level limits and sound emission standards for residential air conditioning devices.

This document replaces Technical Publication NPC-116 "Residential Air Conditioners" of the "Model Municipal Noise Control By-Law, Final Report, August 1978".

TABLE OF CONTENTS

1. Scope . . . . . - 1 -

2. References . . . . . - 1 -

3. Technical Definitions . . . . . - 2 -

4. Sound Level Limits for Air Conditioning Devices . . . . . - 3 -
   (1) General Sound Level Limit . . . . . - 3 -
   (2) Establishment of the General Sound Level Limit . . . . . - 4 -
   (3) Specific Sound Level Limits . . . . . - 4 -

5. Sound Levels from Installed Air Conditioning Devices . . . . . - 5 -

6. Sound Emission Standards . . . . . - 7 -

ANNEX

A.1. Sound Level Measurements - Summary . . . . . - A 1 -

A.2. Sound Level Limits . . . . . - A 1 -

A.3. Complaint Investigation . . . . . - A 2 -

A.4. Installation of Air Conditioning Devices . . . . . - A 3 -

A.5. Sound Emission Standards . . . . . - A 3 -

Publication NPC-216

Residential Air Conditioning Devices

1. Scope

This Publication sets sound level limits and sound emission standards for residential air conditioning devices including heat pumps installed in urban areas of Ontario.

2. References

Reference is made to the following publications, or revisions thereof:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[4] NPC-104 - Sound Level Adjustments

[6] NPC-206 - Sound Levels due to Road Traffic

[10] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376 (1989).

[12] Survey of Outdoor Air Conditioner Noise, Final Report. RAC Report #458G, Ontario Ministry of the Environment, ISBN 0-7729-9094-8 (1991).

[13] Environmental Noise Guidelines for the Installation of Residential Air Conditioning Devices, Ontario Ministry of Environment and Energy, ISBN 0-7778-1616-4 (1994).

[14] ARI* Standard 270 - 84. Sound Rating of Outdoor Unitary Equipment.

[15] ARI* Standard 275 - 84. Application of Sound Rated Outdoor Unitary Equipment.

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* Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203

[16] ANSI Standard S12.32 - 1990. Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms, Precision Methods for the Determination of Sound Power Levels.

References [1] to [6] are also part of the
Model Municipal Noise Control By-Law, Ontario Ministry of the Environment.

3. Technical Definitions

"Ambient sound level"
is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. See Background sound level;

"Background sound level"
means Ambient sound level;

"Class 1 Area"
means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum.

"Class 2 Area"
means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- absence of urban hum between 19:00 and 23:00 hours;
- ambient sound level is defined by natural environment and infrequent human activity; and
- no clearly audible sound from stationary sources* other than from those under consideration.

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* In the context of this Publication, the stationary sources under consideration are residential air conditioning devices.

"Class 3 Area"

means an area with an acoustical environment that is dominated by natural sounds typical of agricultural or wilderness areas and having little or no road traffic, such as the following:

- a small community with less than 1000 population;
- farm land or land zoned rural or agricultural;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

4. Sound Level Limits for Air Conditioning Devices

Either the general sound level limit in Section 4.(1) or the specific sound level limit in Section 4.(3) shall apply to an air conditioning device. The less restrictive of these two limits shall prevail.

(1) General Sound Level Limit

The general sound level limit (shown in Table 216-1 and determined in accordance with Section 4.(2)) is 5 dBA greater than a one hour equivalent sound level (L_{eq}) caused by road traffic at the point of reception during the period of 07:00 to 21:00 hours. The specific hour is to be determined by the noise control officer based on the assessment of annoyance by the complainant.

TABLE 216-1
GENERAL SOUND LEVEL LIMIT

All Air Conditioning Devices	
Area Type	L_{eq} (dBA)
Class 1 and Class 2	One Hour Equivalent Sound Level (L_{eq}) of road traffic plus 5 dBA measured during the period of 07:00 to 21:00 hours

(2) Establishment of the General Sound Level Limit

The general sound level limit shall be established through measurements or calculation of the One Hour Equivalent Sound Level (L_{eq}) caused by road traffic as obtained pursuant to Reference [6] at the point of reception.

(3) Specific Sound Level Limits

Specific sound level limits are identified in Table 216-2 for two types of residential air conditioning devices as minimum limits of compliance.

TABLE 216-2
SPECIFIC SOUND LEVEL LIMITS

Central Air Conditioning Devices	
Area Type	One Hour L_{eq} (dBA)
Class 2	45
Class 1	50*
Window or Through-the-Wall Air Conditioning Devices	
Area Type	One Hour L_{eq} (dBA)
Class 2	45
Class 1	50

* When the devices are mandatory requirements for noise control in the interior living spaces of new land use developments, the specific sound level limit is one hour L_{eq} = 55 dBA.

5. Sound Levels from Installed Air Conditioning Devices

To determine if an installed air conditioning device complies with the sound level limits, the sound level due to the device must be measured following the procedure described in Reference [3].

The procedure assumes that the measured sound is dominated by the source under investigation (air conditioning device). To ensure that the measured sound is dominated by the air conditioning device, sound level measurements must be carried out separately with, and without the device in operation.

The measurement of the background sound level, i.e. without the air conditioning device operating, is carried out in accordance with the procedure described in Reference [3].

If the change in sound level measured separately with, and without the air conditioning device operating is less than 10 dBA, a correction shall be made to determine the contribution of the existing background sound levels to the overall measured sound level. Table 216-3 provides correction values and a example of the calculation.

TABLE 216-3

PROCEDURE RECOMMENDED TO SEPARATE THE SOUND LEVEL OF AN AIR CONDITIONING DEVICE FROM THE BACKGROUND SOUND LEVEL

Change in dBA of Sound Level With and Without Unit in Operation	Correction in dBA to Be Subtracted from Higher Sound Level to Obtain Sound Level from Device
10 or more	0
7 to 9	1
4 to 6	2
3	3
2	4
1	6
0	10

Example:

Sound level without unit in operation		**= 45 dBA**
Sound level with unit in operation		**= 50 dBA**
Change		**= 5 dBA**
Correction from Table		**= 2 dBA**
Unit sound level	**= 50 - 2**	**= 48 dBA**

6. Sound Emission Standards

Table 216-4 gives the sound emission standards for new residential central air conditioning devices.

TABLE 216-4
SOUND EMISSION STANDARDS FOR
RESIDENTIAL CENTRAL AIR CONDITIONING DEVICES

Date of Manufacture	Size (BTUH)	Maximum ARI Standard* Sound Rating (bels)
After 1990-12-31 and Before 1992-01-01	38,900 or less	8.0
After 1991-12-31 and Before 1995-01-01	38,900 or less	7.6
After 1994-12-31	38,900 or less	(Under discussion with the industry to assess the feasibility of reduction.)
BTUH = British Thermal Unit for an Hour		

* Measurement procedure as per Reference [14].

ANNEX

EXPLANATORY NOTES TO PUBLICATION NPC-216 RESIDENTIAL AIR CONDITIONING DEVICES

A.1. Sound Level Measurements - Summary

Verification of compliance of the air conditioner and heat pump units with the sound level limits can be accomplished through measurements using a properly calibrated sound level meter which meets the required standard specifications.

Details of the instrument specifications are included in Reference [2].

The measurements shall be performed outdoors at a sensitive location on neighbouring residential property in the vicinity of the air conditioning device, where the sound of the device may cause annoyance. Typically this would be a patio or a window.

The measurements may also be required at a point of reception in the plane of an open window facing the unit to ensure that the sound level at noise sensitive indoor spaces in a neighbouring residence is not in excess of the guideline limits. Details of the measurement procedure are included in Reference [3].

A.2. Sound Level Limits

People's response to noise varies depending upon the community's, as well as the individual's economic and social relationship to the source. The sound level limits for air conditioner and heat pump noise were established based on the results of sociological surveys of large numbers of people and represent what is considered to be the onset of significant degradation of the noise environment relative to the expectations of the general population.

The sound level limits are receptor oriented, i.e. they apply at any noise sensitive location within a Class 2 or Class 1 Area (as defined in NPC-216) at which sound from the air conditioning device may cause annoyance.

The specific limits shown in Table 216-2 are expressed in terms of the one hour equivalent sound level L_{eq}, and apply to receptor locations in Class 1 and Class 2 Areas.

A separate limit applies to those receptor locations in Class 1 Areas where the unit was a mandatory requirement for noise control of the interior living space in new land use developments.

A preemption in the form of a general limit applies in an area of a relatively high background noise caused by road traffic as shown in Table 216-1. In accordance with this pre-emption, the existing background sound level, if higher than the limits in Table 216-2, represents the criterion of acceptability for the air conditioning device operation. In addition, the general limits are increased by 5 dBA for any hour from 07:00 to 21:00 hours. The period of assessment was chosen in accordance with the findings of a sociological survey conducted in 1990, Reference [12].

A.3. Complaint Investigation

Investigators of a complaint against installed air conditioning devices must carry out sound level measurements at the receptor location(s). The measurements are to be made in accordance with methods identified in Section A.1. The operating sound of the air conditioning device and the background sound consisting of the road traffic noise must be measured at the same location, separately. While the background sound level is measured the air conditioning device must be turned off. Contributions from aircraft and rail noise sources must be inhibited at all times. Unattended measurements are not recommended. Atmospheric conditions may have significant influence on the ambient sound levels, for details see Reference [3].

The sound level of an installed air conditioning device may be calculated from the sound levels measured with the device operating (device plus background noise) and without it operating (background only). The procedure is described in Section 5. A correction value is determined between these two sound levels. Subtracting this correction from the higher sound level (measured with the device in operation) gives the sound level due to the air conditioning device itself. See Table 216-3.

Determination of the road traffic sound level is to be made by the noise control officer based on the assessment of the annoyance by the complainant(s). The time of highest annoyance within the time period of 07:00 to 21:00 is to fall in the selected one hour of the road traffic noise.

A.4. Installation of Air Conditioning Devices

Purchasers and installers of air conditioning devices have to be cognizant of the MOEE guideline on the Sound Emission Standards listed in Table 216-4. Further explanation of the standards is provided in Section A.5. Only units meeting the requirements of Table 216-4 may be installed in Ontario.

For guidance on the selection, location or sound rating of the air conditioning devices or for the method to estimate the sound levels, installers should refer to Reference [13].

Installation of units that are in compliance with the sound emission standard must also be in compliance with the point of reception sound level limits, i.e. complying with the least restrictive sound level limit of Tables 216-1 and 216-2.

If the calculated sound level of the unit is in excess of the specific sound level limit (Table 216-2), the general sound level limit is to be determined. If both limits are exceeded by the calculated levels then alteration is needed in one or more of the following: the size or make of unit, its location or the type of noise reducing installation treatment (use of barrier or enclosure).

Owners of installed units producing a sound level in excess of the sound level limits will be required to reduce the noise of the unit, when faced with complaints.

Noise abatement is more expensive and less cost effective than a proper installation.

A.5. Sound Emission Standards

In contrast to the sound level limits which apply at the point of reception, sound emission standards are source oriented, and are based on the concept of sound power level which is a basic measure of the acoustic output of a noise source.

The sound level of the air conditioner or heat pump at a receptor location depends on many factors such as distance separation, unit's orientation with respect to the receptor, presence of shielding objects or structures, intervening terrain, topography and ground cover between the unit and receptor, as well as on atmospheric conditions, all of which are independent of the actual sound emission of the unit.

Sound power on the other hand is a fundamental property of the acoustic source alone and is, therefore, an important absolute parameter which is widely used for rating and comparing sound sources.

The rating of air conditioner and heat pump equipment is designated as the ARI Sound Rating (SR*) and is provided by the manufacturer of the device.

The Sound Rating is based on laboratory tests performed at Standard Rating Conditions in accordance with References [14] and [16]. The SR is an indicator of the sound power level of the equipment; the lower the SR, the lower the sound power of the air conditioner or heat pump.

Sound Emission Standards in Table 216-4 apply to central air conditioning devices only and not for window or through-the-wall units.

The maximum acceptable ARI Standard Sound Ratings shown in Table 216-4 are set in accordance with the date of manufacture. Two Sound Emission Standards, 8.0 and 7.6 bels are specified for air conditioner and heat pump units manufactured during 1991, and during 1992 through 1994 respectively. The Sound Emission Standard applies to units that are sized at 38,900 BTUH capacity or less. The emission limits projected after 1994 are under discussion with the industry to assess the feasibility of reduction.

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* SR is a tone corrected A-weighted sound power level, expressed in bels.

APPENDIX B

AIR CONDITIONING DEVICE INSTALLATION CHECKLIST FOR NOISE CONTROL IN URBAN AREAS

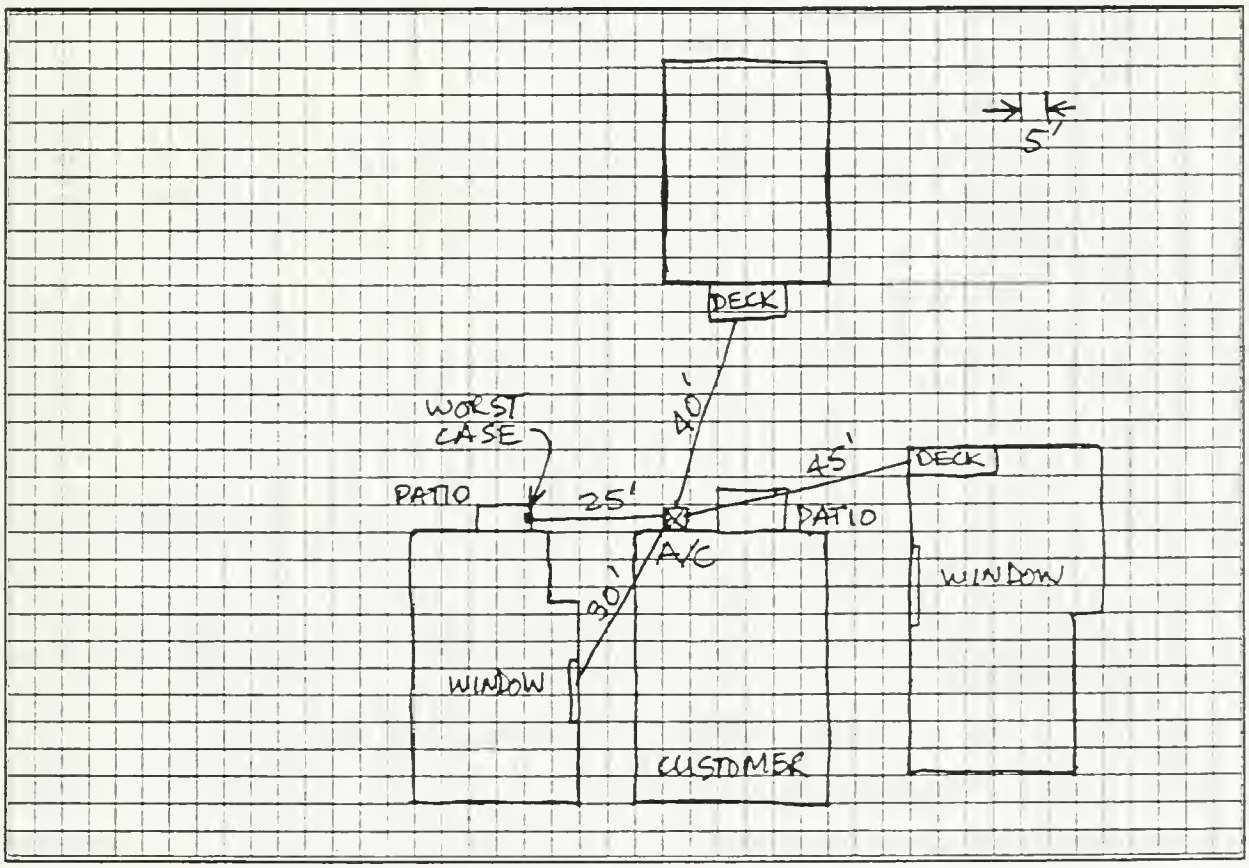
APPENDIX B
AIR CONDITIONING DEVICE INSTALLATION
CHECKLIST FOR NOISE CONTROL IN URBAN AREAS

A. Location of Installation: 18 FIRST AVE., MYTOWN

Addresses:	Purchaser	Installer	Regulatory Authority
Name:	MR. JONES	SUPERAIR	CITY OF MYTOWN
Address:	18 FIRST AVE.	1 INDUSTRY DR.	1 CITY DRIVE
City/ Province	MYTOWN	MYTOWN	MYTOWN
Tel:	555-5551	555-5552	555-5553

B. PROPOSED CONDENSING UNIT LOCATION

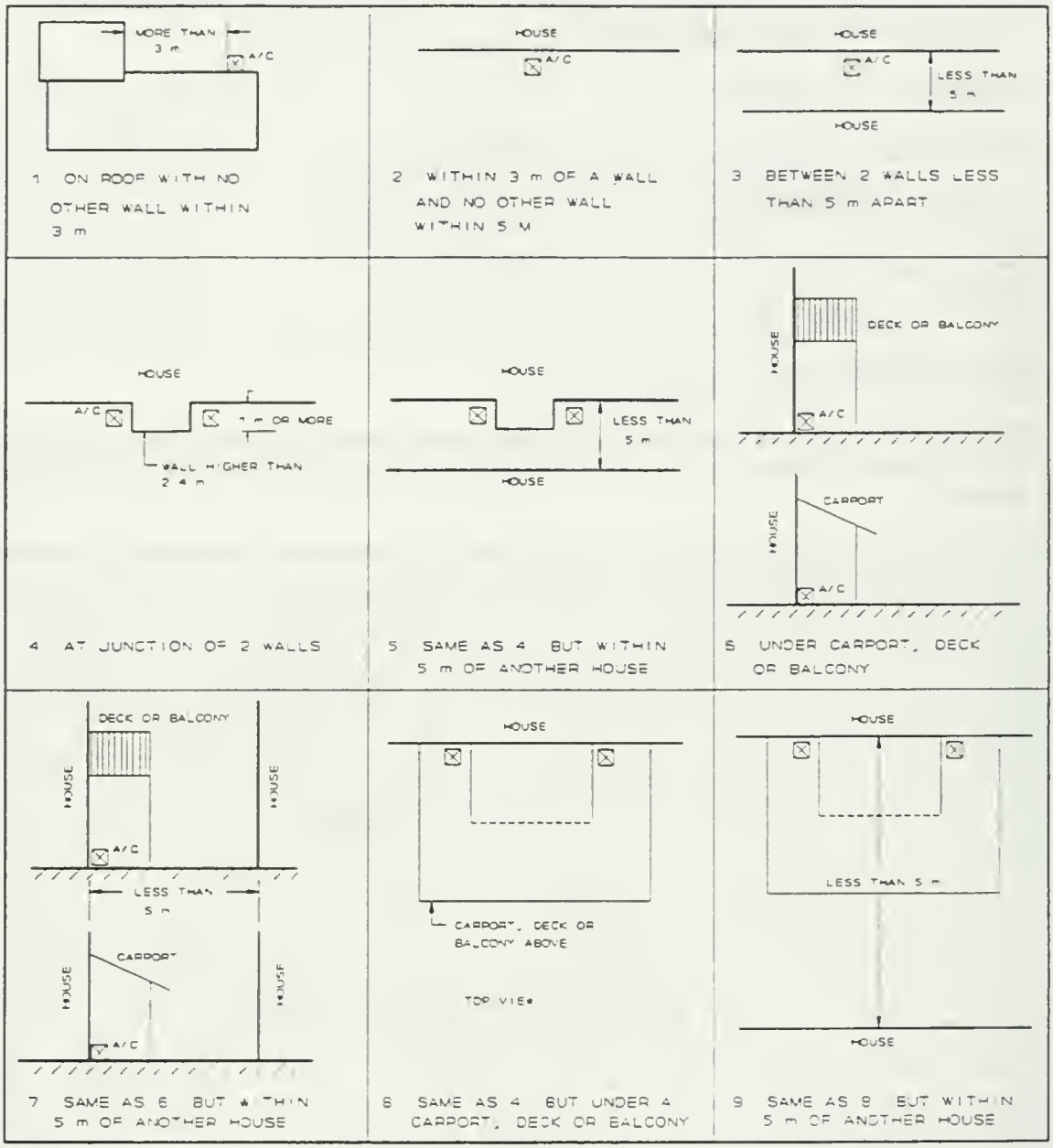
B1. Sketch of customer's house and surrounding houses within 20 m (60 ft.). Show proposed A/C location and closest receptor positions. Include neighbours behind as well as to the side. Draw straight line between A/C and receptor.



B2. Identify Receptor location: [✓] patio [ ] deck [ ] sliding glass door [ ] window.

B3. Enter distance between A/C and Receptor: 25 [ ] m [✓] ft.

B4. Select A/C location number from options below 2 (1 to 9)



C. SOUND LEVEL LIMIT

a) [ ] 55 dBA: A/C is a mandatory requirement for transportation noise control

b) [ ] 50 dBA: Average urban area, Class 1

c) [M] 45 dBA: Quiet urban area, Class 2

d) [ ] Noisy urban area close to roads, railways or airports: Sound measurements of ambient due to road traffic needed in accordance with NPC-216. Limit is ambient + 5 dBA.

Enter ambient sound level: ____ dBA

Add: 5 dBA

= ____ dBA Sound level Limit

D. CONDENSING UNIT SOUND RATING WITHOUT A BARRIER

For Sound Level Limits a), b) and c) of Section C: Select condensing unit Bel rating using the table below. Circle sound level limit, location option, distance and bel rating.

For Sound Level Limit d) of Section C: Use the column for 45 dBA and add the correction below:

Sound Level limit d) = ____ dBA
Subtract 45 dBA
Correction 1. = ____ dBA ÷ 10 = ____ Bels

For a window or through-the-wall unit:
Use the table below and the following correction:

Correction 2. = 0.3 Bels.

Sound Level Limit is 45 dBA		Sound Level Limit is 50 dBA		Sound Level Limit is 55 dBA		A/C Location (From Section B4)				
						Option 1	Option 2	Options 3, 4, 6	Options 5, 7, 8	Option 9
Distance from A/C to Receptor						Maximum Permissible Bel Rating				
(m)	(ft.)	(m)	(ft.)	(m)	(ft.)					
4.1	13	2.3	7.5	1.3	4.3	6.5	6.2	5.9	5.6	5.3
4.6	15	2.6	8.5	1.4	4.6	6.6	6.3	6.0	5.7	5.4
5.2	17	2.9	9.5	1.6	5.3	6.7	6.4	6.1	5.8	5.5
5.8	19	3.3	11	1.8	5.9	6.8	6.5	6.2	5.9	5.6
6.5	21	3.7	12	2.0	6.6	6.9	6.6	6.3	6.0	5.7
7.3	24	4.1	13	2.3	7.5	7.0	6.7	6.4	6.1	5.8
8.2	27	4.6	15	2.6	8.5	7.1	6.8	6.5	6.2	5.9
9.2	30	5.2	17	2.9	9.5	7.2	6.9	6.6	6.3	6.0
10.3	34	5.8	19	3.3	11	7.3	7.0	6.7	6.4	6.1
11.6	38	6.5	21	3.7	12	7.4	7.1	6.8	6.5	6.2
13.0	43	7.3	24	4.1	13	7.5	7.2	6.9	6.6	6.3
14.6	48	8.2	27	4.6	15	7.6	7.3	7.0	6.7	6.4
16.4	54	9.2	30	5.2	17	7.7	7.4	7.1	6.8	6.5
18.4	60	10.3	34	5.8	19	7.8	7.5	7.2	6.9	6.6
20.7	68	11.6	38	6.5	21	7.9	7.6	7.3	7.0	6.7
23.2	76	13.0	43	7.3	24	8.0	7.7	7.4	7.1	6.8
26.0	85	14.6	48	8.2	27	8.1	7.8	7.5	7.2	6.9
29.2	96	16.4	54	9.2	30	8.2	7.9	7.6	7.3	7.0
32.8	108	18.4	60	10.3	34	8.3	8.0	7.7	7.4	7.1
36.8	121	20.7	68	11.6	38	8.4	8.1	7.8	7.5	7.2
41.3	135	23.2	76	13.0	43	8.5	8.2	7.9	7.6	7.3
46.4	152	26.0	85	14.6	48	8.6	8.3	8.0	7.7	7.4
52.0	171	29.2	96	16.4	54	8.7	8.4	8.1	7.8	7.5
58.4	192	32.8	108	18.4	60	8.8	8.5	8.2	7.9	7.6
65.6	215	36.8	121	20.7	68	8.9	8.6	8.3	8.0	7.7
73.6	241	41.3	135	23.2	76	9.0	8.7	8.4	8.1	7.8

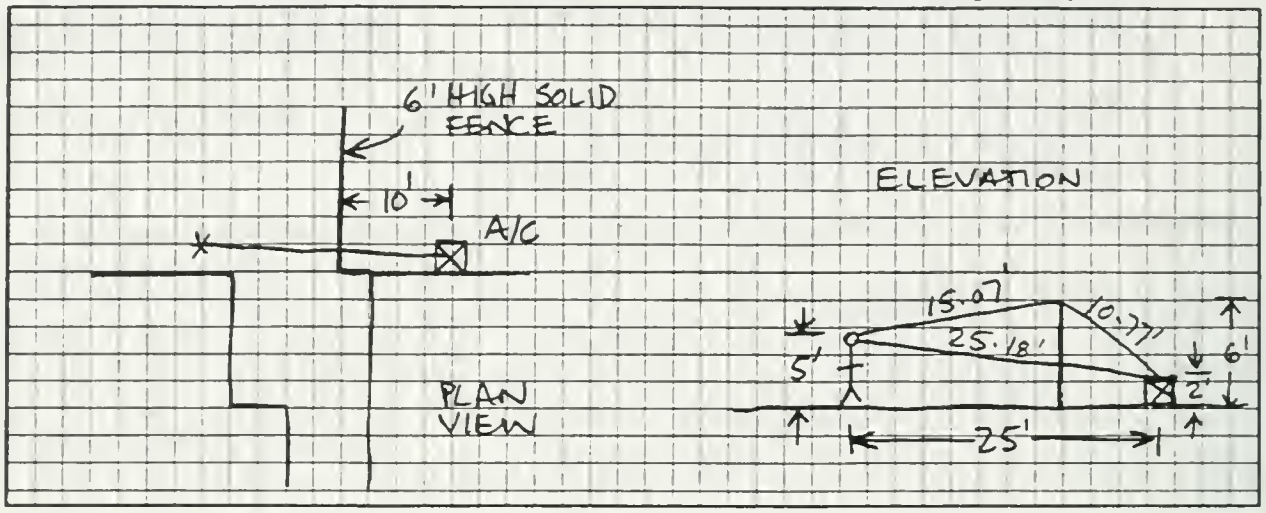
BEL RATING = 6.7 Bels + / (Correction 1.) + / (Correction 2.) = 6.7 BELS (D)

FOR SOUND LEVEL LIMIT = 45 dBA

If a unit with the above rating is not available, consider barrier effect of fences or other objects as given in Section E.

E. CONDENSING UNIT SOUND RATING WITH A BARRIER

Barriers can consist of fences, buildings or corners of houses. See guide for possible barrier configuration Sketch details in box below. Measure distances using tape to 2 decimal place accuracy: 1/100 ft. or 1/100 e.g. 6.34 ft., 2.17 m. Note: Barriers located between two reflective surfaces are generally not effective.



Type of barrier: [ ] House Wall [M] Fence [ ] Solid Barrier [ ] Shed [ ] Other:_____
[ ] **Existing** [ ] **Proposed:**

1. Distance from centre of fan to barrier corner or top: 10.77 [ ] m [M] ft.
2. Distance from receptor point to barrier corner or top: 15.07 [ ] m [M] ft.
3. Sum of 1. and 2. above: 25.84 [ ] m [M] ft.
4. Distance from centre of fan to receptor point: 25.18 [ ] m [M] ft.
5. Path length difference (PLD)(Subtract 4. from 3.): 0.66 [ ] m [M] ft.
6. Barrier Shielding Factor: 0.5 bels (circle closest value in table below)

PLD	m	10	.15	.20	.25	.30	.40	.50	.60	.75	.90	1.15	1.50	1.85	2.80	3.70
	ft.	.33	.49	.66	.82	.98	1.3	1.6	2.0	2.5	3.0	3.8	4.9	6.1	9.2	12.1
Factor (bels)		.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7

7. Bel Rating (D) from Section D: 6.7 bels

Sum of 6. and 7. = 7.2 bels rating with barrier to meet 45 dBA at Receptor Location.

F. SELECTED CONDENSING UNIT SOUND RATING

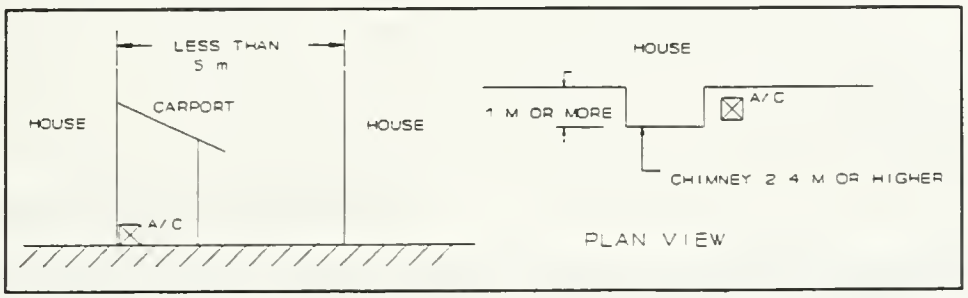
FINAL SELECTED BEL RATING = 7.2 BELS TO MEET SOUND LEVEL LIMIT OF : 45 dBA

Note: Maximum 7.6 bels for 38,900 BTUH or less.
Bel rating must be rounded down to the next even tenth e.g. .0, .2, .4, .6 or .8.
If bel rating not available, consider an acoustic enclosure or a water cooled condenser if acceptable to manufacturer and municipality.

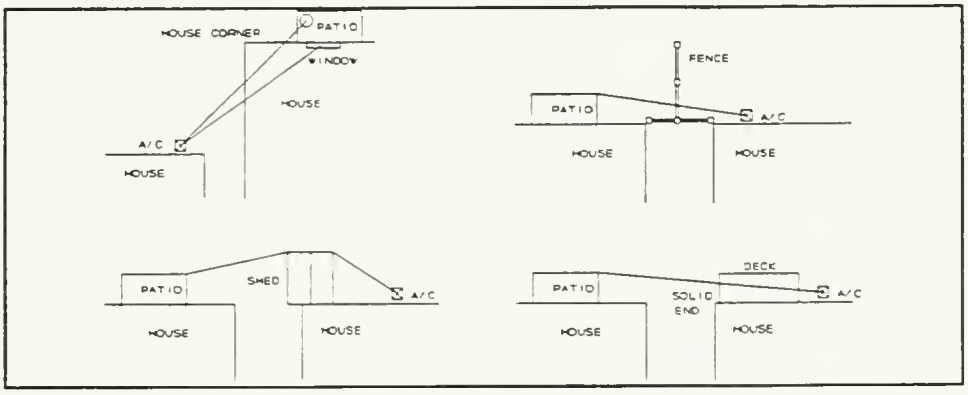
GUIDE TO USE OF INSTALLATION CHECKLIST

1. The centre of the A/C unit is considered to be the centre of the fan. Outdoor receptors are assumed to be 1.5 m (5 ft.) above the ground. For receptors at windows, use centre of the window.

2. A reflective surface can be a wall, the roof of a carport, the underside of a balcony or underside of a deck. For a chimney or other projection to be considered a reflective surface, it must be at least 1 m (3 ft.) in length and at least 2.4 m (8 ft.) high. See diagram below.



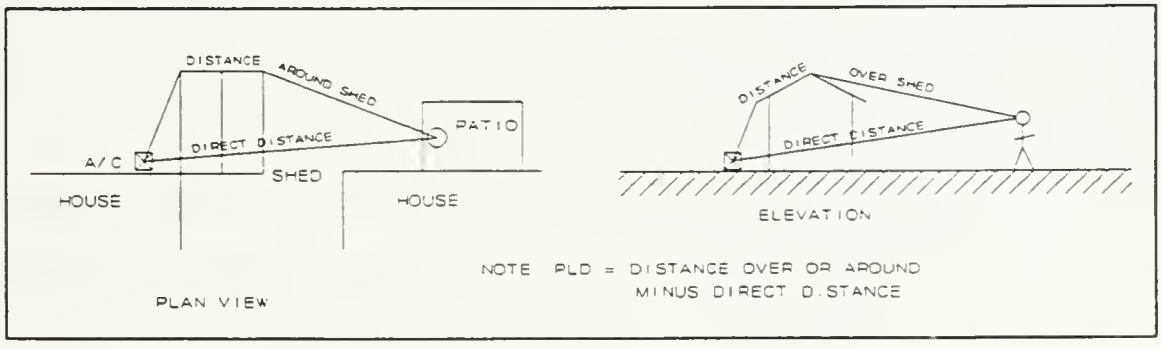
3. Possible barrier configurations are shown below:



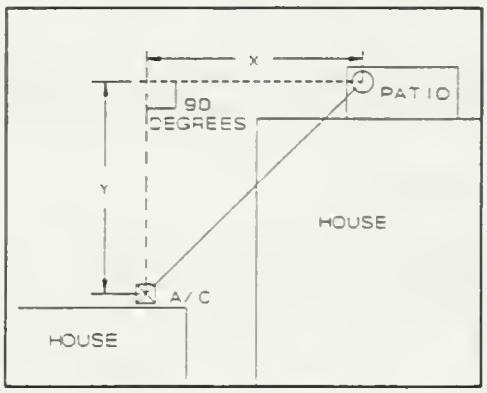
4. The effectiveness of a barrier is directly related to the extra distance the sound must travel around the object compared to the direct distance between source and receiver. This is called the path length difference (PLD). If a deck or garden shed is to be treated as a barrier, the shorter of the following is to be used:

- the path horizontally around the barrier
- the path vertically over the barrier

See below.



5. For situations where the direct distance between A/C and receptor cannot be measured, use the calculatio below. Measure two distances that are 90 degrees to each other. The ends of the lines should line up with th ends of the direct distance line wanted.



Measured Distance X.....: ____ (1)

X^2.....: ____ (2)

Measured Distance Y:.....: ____ (3)

Y^2.....: ____ (4)

(2) + (4).....: ____ (5)

Square root of (5): ____ = Direct Distance

6. Barriers located between two reflecting surfaces are generally not effective and are not recommended.

7. If a fence is to be used as a barrier, it must be solid with no holes or gaps. Adding another row of boards to "board on board" fence is acceptable.

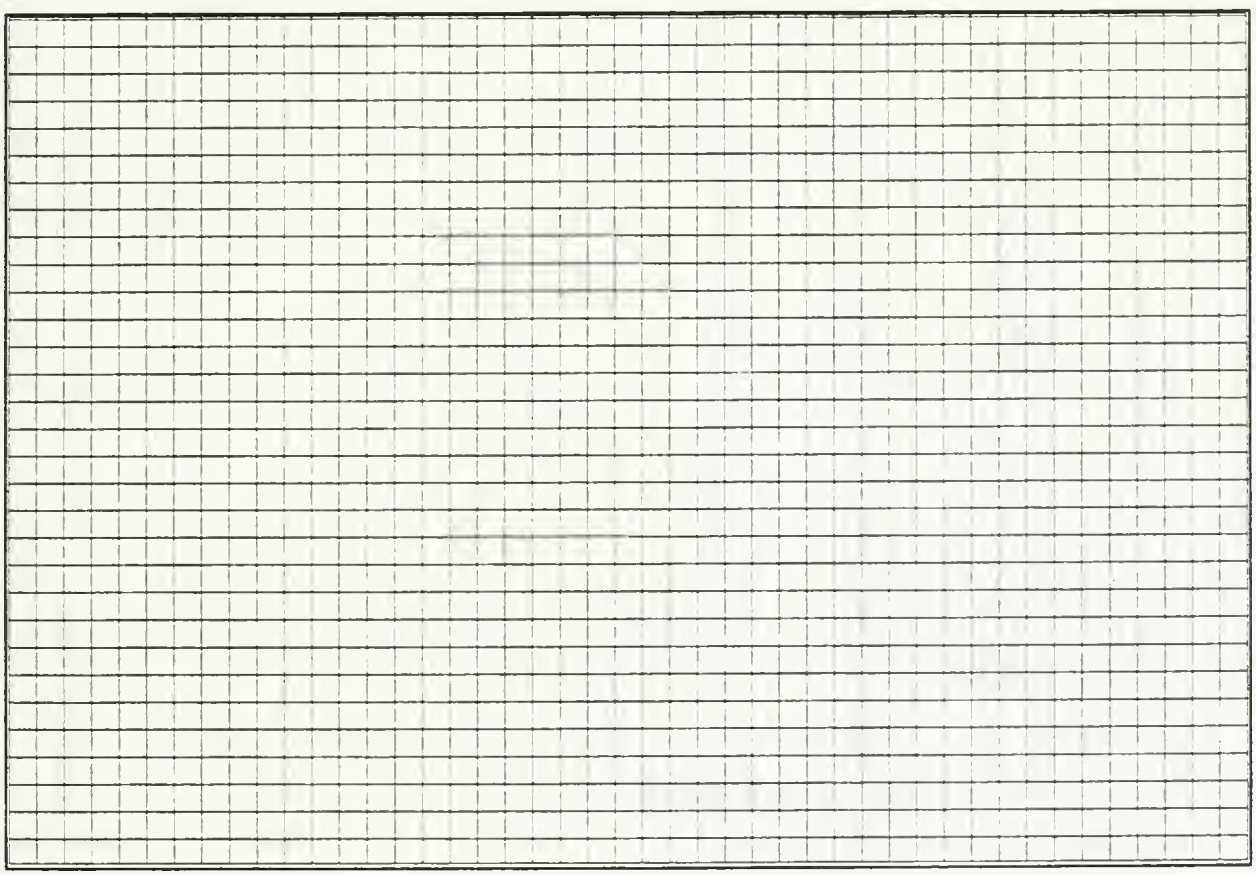
APPENDIX B
AIR CONDITIONING DEVICE INSTALLATION
CHECKLIST FOR NOISE CONTROL IN URBAN AREAS

A. Location of Installation: _____

Addresses:	Purchaser	Installer	Regulatory Authority
Name:	_____	_____	_____
Address:	_____	_____	_____
City/ Province	_____	_____	_____
Tel:	_____	_____	_____

B. PROPOSED CONDENSING UNIT LOCATION

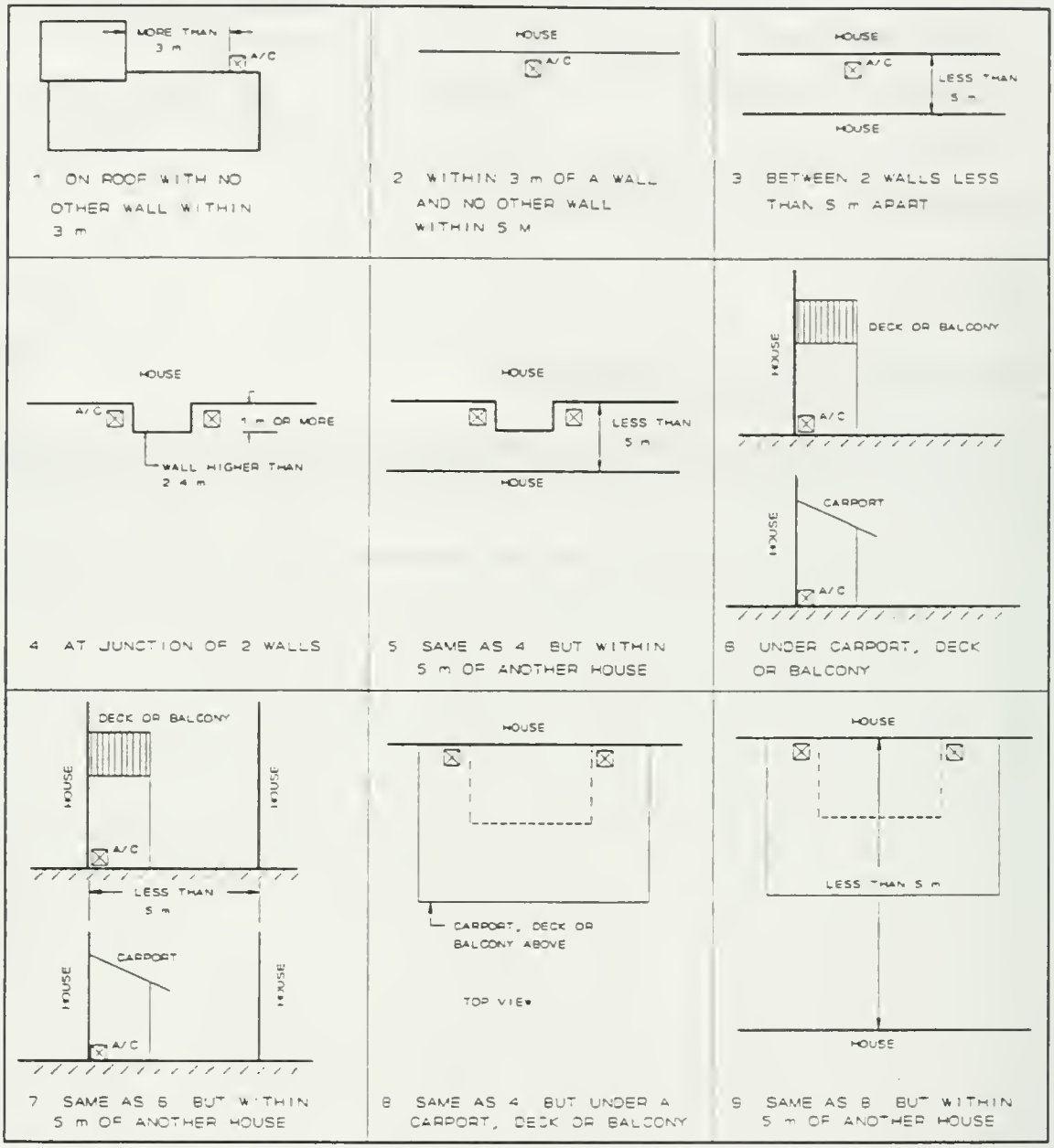
B1. Sketch of customer's house and surrounding houses within 20 m (60 ft.). Show proposed A/C location and closest receptor positions. Include neighbours behind as well as to the side. Draw straight line between A/C and receptor.



B2. Identify Receptor location: [ ] patio [ ] deck [ ] sliding glass door [ ] window.

B3. Enter distance between A/C and Receptor: _____ [ ] m [ ] ft.

B4. Select A/C location number from options below ____ (1 to 9)



C. SOUND LEVEL LIMIT

a) [ ] 55 dBA: A/C is a mandatory requirement for transportation noise control

b) [ ] 50 dBA: Average urban area, Class 1

c) [ ] 45 dBA: Quiet urban area, Class 2

d) [ ] Noisy urban area close to roads, railways or airports: Sound measurements of ambient due to road traffi needed in accordance with NPC-216. Limit is ambient + 5 dBA.

Enter ambient sound level: ____ dBA

Add: 5 dBA

= ____ dBA Sound level Limit

D. CONDENSING UNIT SOUND RATING WITHOUT A BARRIER

For Sound Level Limits a), b) and c) of Section C: Select condensing unit Bel rating using the table below. Circle sound level limit, location option, distance and bel rating.

For Sound Level Limit d) of Section C: Use the column for 45 dBA and add the correction below:

Sound Level limit d) = ____ dBA
Subtract 45 dBA
Correction 1. = ____ dBA ÷ 10 = ____ Bels

For a window or through-the-wall unit: Use the table below and the following correction:

Correction 2. = 0.3 Bels.

Sound Level Limit is 45 dBA		Sound Level Limit is 50 dBA		Sound Level Limit is 55 dBA		A/C Location (From Section B4)				
						Option 1	Option 2	Options 3, 4, 6	Options 5, 7, 8	Option 9
Distance from A/C to Receptor						Maximum Permissible Bel Rating				
(m)	(ft.)	(m)	(ft.)	(m)	(ft.)					
4.1	13	2.3	7.5	1.3	4.3	6.5	6.2	5.9	5.6	5.3
4.6	15	2.6	8.5	1.4	4.6	6.6	6.3	6.0	5.7	5.4
5.2	17	2.9	9.5	1.6	5.3	6.7	6.4	6.1	5.8	5.5
5.8	19	3.3	11	1.8	5.9	6.8	6.5	6.2	5.9	5.6
6.5	21	3.7	12	2.0	6.6	6.9	6.6	6.3	6.0	5.7
7.3	24	4.1	13	2.3	7.5	7.0	6.7	6.4	6.1	5.8
8.2	27	4.6	15	2.6	8.5	7.1	6.8	6.5	6.2	5.9
9.2	30	5.2	17	2.9	9.5	7.2	6.9	6.6	6.3	6.0
10.3	34	5.8	19	3.3	11	7.3	7.0	6.7	6.4	6.1
11.6	38	6.5	21	3.7	12	7.4	7.1	6.8	6.5	6.2
13.0	43	7.3	24	4.1	13	7.5	7.2	6.9	6.6	6.3
14.6	48	8.2	27	4.6	15	7.6	7.3	7.0	6.7	6.4
16.4	54	9.2	30	5.2	17	7.7	7.4	7.1	6.8	6.5
18.4	60	10.3	34	5.8	19	7.8	7.5	7.2	6.9	6.6
20.7	68	11.6	38	6.5	21	7.9	7.6	7.3	7.0	6.7
23.2	76	13.0	43	7.3	24	8.0	7.7	7.4	7.1	6.8
26.0	85	14.6	48	8.2	27	8.1	7.8	7.5	7.2	6.9
29.2	96	16.4	54	9.2	30	8.2	7.9	7.6	7.3	7.0
32.8	108	18.4	60	10.3	34	8.3	8.0	7.7	7.4	7.1
36.8	121	20.7	68	11.6	38	8.4	8.1	7.8	7.5	7.2
41.3	135	23.2	76	13.0	43	8.5	8.2	7.9	7.6	7.3
46.4	152	26.0	85	14.6	48	8.6	8.3	8.0	7.7	7.4
52.0	171	29.2	96	16.4	54	8.7	8.4	8.1	7.8	7.5
58.4	192	32.8	108	18.4	60	8.8	8.5	8.2	7.9	7.6
65.6	215	36.8	121	20.7	68	8.9	8.6	8.3	8.0	7.7
73.6	241	41.3	135	23.2	76	9.0	8.7	8.4	8.1	7.8

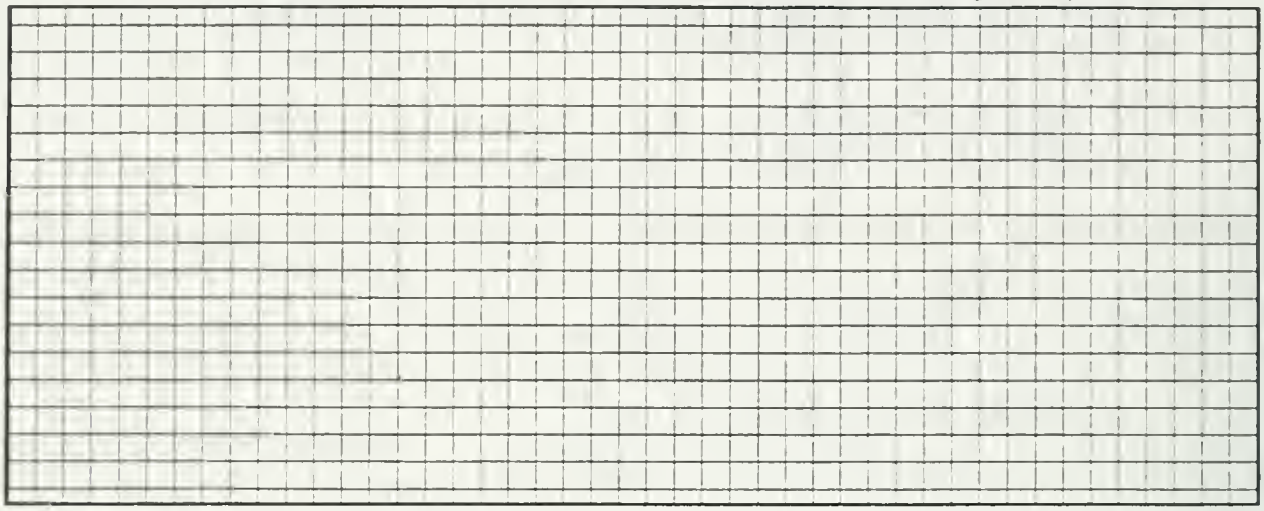
BEL RATING = ____ Bels + ____ (Correction 1.) + _____ (Correction 2.) = _____ BELS (D)

FOR SOUND LEVEL LIMIT = _____ dBA

If a unit with the above rating is not available, consider barrier effect of fences or other objects as given in Section E.

E. CONDENSING UNIT SOUND RATING WITH A BARRIER

Barriers can consist of fences, buildings or corners of houses. See guide for possible barrier configuration Sketch details in box below. Measure distances using tape to 2 decimal place accuracy: 1/100 ft. or 1/100 n e.g. 6.34 ft., 2.17 m. Note: Barriers located between two reflective surfaces are generally not effective.



Type of barrier: [ ] House Wall [ ] Fence [ ] Solid Barrier [ ] Shed [ ] Other:_____
[ ] Existing [ ] Proposed:

1. Distance from centre of fan to barrier corner or top: _____ [ ] m [ ] ft.

2. Distance from receptor point to barrier corner or top: _____ [ ] m [ ] ft.

3. Sum of 1. and 2. above: _____ [ ] m [ ] ft.

4. Distance from centre of fan to receptor point: _____ [ ] m [ ] ft.

5. Path length difference (PLD)(Subtract 4. from 3.): _____ [ ] m [ ] ft.

6. Barrier Shielding Factor: _____ bels (circle closest value in table below)

PLD	m	.10	15	.20	.25	.30	.40	.50	.60	.75	.90	1.15	1.50	1.85	2.80	3.70
	ft.	.33	.49	.66	.82	.98	1.3	1.6	2.0	2.5	3.0	3.8	4.9	6.1	9.2	12.1
Factor (bels)		.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7

7. Bel Rating (D) from Section D: _____ bels

Sum of 6. and 7. = _____ bels rating with barrier to meet _____ dBA at Receptor Location.

F. SELECTED CONDENSING UNIT SOUND RATING

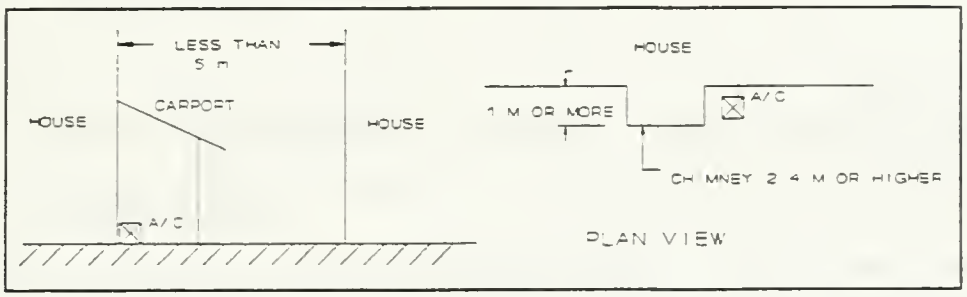
FINAL SELECTED BEL RATING = _____ BELS TO MEET SOUND LEVEL LIMIT OF : _____ dBA.

Note: Maximum 7.6 bels for 38,900 BTUH or less.
Bel rating must be rounded down to the next even tenth e.g. .0, .2, .4, .6 or .8.
If bel rating not available, consider an acoustic enclosure or a water cooled condenser if acceptable t manufacturer and municipality.

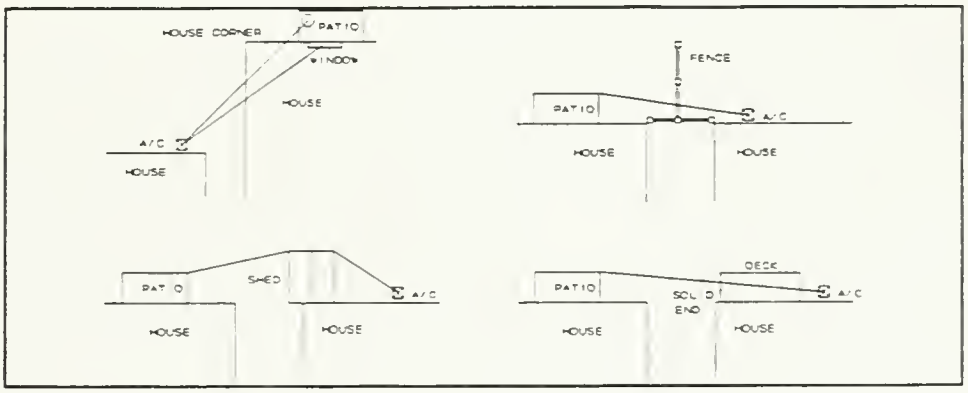
GUIDE TO USE OF INSTALLATION CHECKLIST

1. The centre of the A/C unit is considered to be the centre of the fan. Outdoor receptors are assumed to be 1.5 m (5 ft.) above the ground. For receptors at windows, use centre of the window.

2. A reflective surface can be a wall, the roof of a carport, the underside of a balcony or underside of a deck. For a chimney or other projection to be considered a reflective surface, it must be at least 1 m (3 ft.) in length and at least 2.4 m (8 ft.) high. See diagram below.



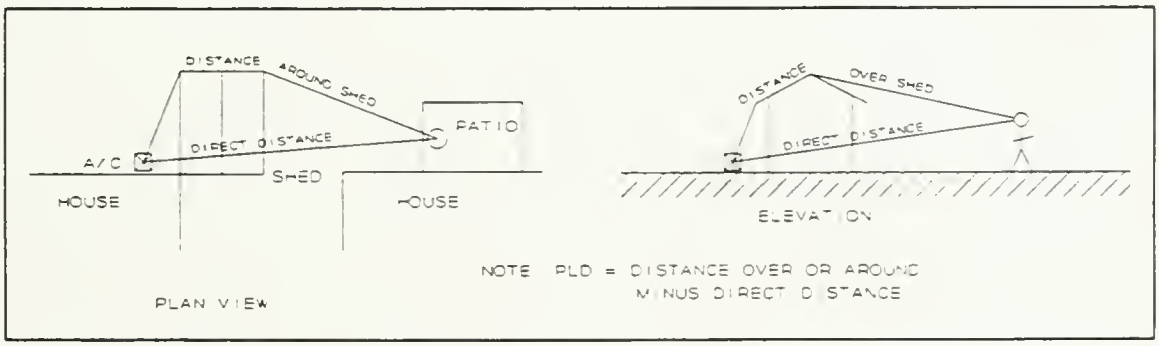
3. Possible barrier configurations are shown below:



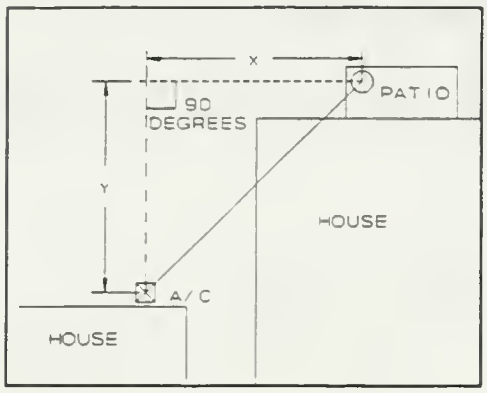
4. The effectiveness of a barrier is directly related to the extra distance the sound must travel around the object compared to the direct distance between source and receiver. This is called the path length difference (PLD). If a deck or garden shed is to be treated as a barrier, the shorter of the following is to be used:

- the path horizontally around the barrier
- the path vertically over the barrier

See below.



5. For situations where the direct distance between A/C and receptor cannot be measured, use the calculation below. Measure two distances that are 90 degrees to each other. The ends of the lines should line up with the ends of the direct distance line wanted.



Measured Distance X.....: ____ (1)

X^2.....: ____ (2)

Measured Distance Y:.....: ____ (3)

Y^2.....: ____ (4)

(2) + (4).....: ____ (5)

Square root of (5): ____ = Direct Distance

6. Barriers located between two reflecting surfaces are generally not effective and are not recommended.

7. If a fence is to be used as a barrier, it must be solid with no holes or gaps. Adding another row of boards to a "board on board" fence is acceptable.

APPENDIX C

AIR CONDITIONING DEVICE NOISE INVESTIGATION CHECKLIST

APPENDIX C

AIR CONDITIONING DEVICE NOISE
INVESTIGATION CHECKLIST

A. GENERAL INFORMATION

DATE: JUNE 30/93 TIME: 3 p.m.

ADDRESS OF A/C UNIT LOCATION 12 FIRST AVE. (BROWN)

ADDRESS OF COMPLAINANT 10 FIRST AVE. (SMITH)

INVESTIGATOR ABC

1) What type of unit is installed?
[ ] Window
[ ] Wall
[✓] Central

2) Does the sound have an audible tonal characteristic or rattle? Y / (N)
If yes, describe

3) Does there seem to be a vibration? Y / (N)
If yes, describe

4) Was the owner made aware of the problem, if any? (Y) N
If so how?
I spoke to Mr. Brown at #12

5) What action is the owner willing to take in abating the problem? Move unit or add a simple barrier

6) When was the air conditioner device installed? 1989

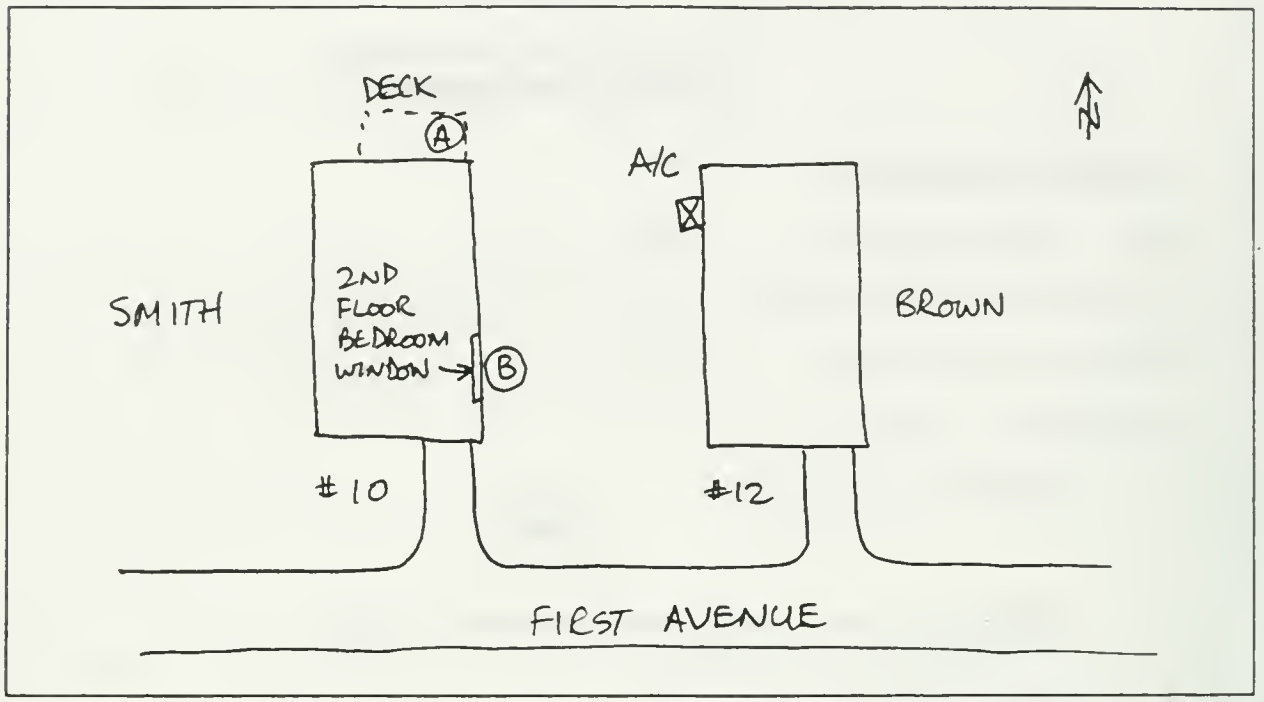
7) Identify: Make: DEEPFREEZE
Model: SNOWSTORM 300
Serial No.: 123456-AB

Sound Emission Limit for central units of 38,900 BTUH or less only (check with manufacturer):

[✓] Manufactured before 1991: no limit
[ ] Bel rating if manufactured in 1991: ____ bels (limit 8.0)
[ ] Bel rating if manufactured in 1992 or later: ____ bels (limit 7.6)

Does an excess exist? Y / (N)

B. SKETCH OF MEASUREMENT LOCATION (outdoor patio/deck or window)



PHOTOS REQUIRED TO BE TAKEN
(Attach here)

NOTE: Prepare sketch to show location of complainant's property, location of air conditioner, and any objects or structures between the air conditioner and any point of reception. All sketches must show the measured distance between points of reference. Patio/deck measurement location is 1.5 m above ground/floor. Window measurement location is middle of full open area of window.

C. SOUND MEASUREMENT DATA SHEET

INSTRUMENTATION

	Make	Model	Serial #
Sound Level Meter	SILENCER	100	1234
Microphone	"	200 (½ INCH)	7654
Calibrator	"	350	5656

INSTRUMENTATION CHECK

	Before	After
Calibration of Meter	94.0	94.0
Battery Check (%)	83	80

MEASUREMENT CONDITIONS

Time	3 p.m.	Temperature	27°C
Wind Speed	NIL	Precipitation	NIL
Wind Direction	NIL	Relative Humidity	90%

D. SOUND LEVELS

D1. AMBIENT MEASUREMENTS

Enter results of measurements in the table below. Note that ambient is due to road traffic only and excludes sources such as aircraft, trains, people, animals, mechanical equipment, etc.

AMBIENT WITH A/C OFF (20 minute minimum required per NPC-103 Section 4):				
LOCATION	Leq READING (dBA)	TIME		DURATION MINUTES
		START	END	
A	(A1) 44	3:10 pm	3:30 pm	20
B	(B1) 46	3:35 pm	3:55 pm	20
C	(C1)			

Identify any sources inhibited during measurements: none

D2. SOUND LEVEL LIMIT

Select the applicable sound level limit from below. Use the less restrictive of the general or the specific sound level limit.

General Sound Level Limit

One hour Equivalent Sound Level of road traffic + 5 dBA measured during the period 07:00 to 21:00 hours.

Use ambient sound level obtained in D1 + 5 dBA.

LOCATION A: AMBIENT(A1) = 44 + 5 = 49 dBA
LOCATION B: AMBIENT(B1) = 46 + 5 = 51 dBA
LOCATION C: AMBIENT(C1) = ____ + 5 = ____ dBA

Specific Sound Level Limit

Check with municipality for Class rating.

a) A/C is a mandatory requirement for transportation noise control: [ ] 55 dBA

b) Moderately noisy urban area, Class 1: [ ] 50 dBA

c) Quiet urban area, Class 2: [✓] 45 dBA

Identify the less restrictive (higher) sound level limit and enter the sound level limits below.

LOCATION	LESS RESTRICTIVE LIMIT		SOUND LEVEL LIMIT (dBA)
A	[✓] general	[ ] specific	(L1) 49
B	[✓] general	[ ] specific	(L2) 51
C	[ ] general	[ ] specific	(L3)

D3. SHORT MEASUREMENT WITH A/C ON

Enter results of measurements with A/C in operation in the table below. Include only road traffic and the A/C unit. Exclude sources such as aircraft, trains, people, animals, other mechanical equipment, etc. Enter sound level limit from above and calculate difference.

A/C ON: Use average of three 15 second readings per NPC-103 Section 3 for steady sound							
		READING (dBA)					
LOCATION	TIME	1.	2.	3.	AVERAGE (dBA)	LIMIT (dBA)	DIFFERENCE (dBA)
A	4:05 pm	53	53	53	(A2) 53	(L1) 49	(A2 - L1) 4
B	4:07 pm	51	51	51	(B2) 51	(L2) 51	(B2 - L2) ∅
C					(C2)	(L3)	(C2 - L3)

LOCATION

Is difference more than zero? A: (Y)N, B: Y(N), C: Y/N

If No and if unit is not tonal, proceed to Part F and insert average values (A2, B2 or C2) for A/C only values (A4, B4 or C4). Otherwise, continue with D4 below.

D4. DIFFERENCE BETWEEN A/C ON AND AMBIENT

Determine the difference in sound level between A/C on and ambient using the table below.

LOCATION	A/C ON (dBA), FROM D3.	AMBIENT (dBA), FROM D1.	DIFFERENCE (dBA)
A	(A2) 53	(A1) 44	(A2-A1) 9
B	(B2)	(B1)	(B2-B1)
C	(C2)	(C1)	(C2-C1)

	LOCATION		
	A	B	C
Is difference between A/C ON and A/C OFF less than 10 dBA?	(Y)/N	Y/N	Y/N

If No, use A/C ON readings as A/C ONLY readings and continue to Part D6. [ ]A [ ] B [ ] C
If Yes, measure A/C for 20 minutes. [✓] A [ ] B [ ] C

D5. 20 MINUTE MEASUREMENT WITH A/C ON AND DIFFERENCE FROM AMBIENT

Enter results of measurements with the A/C in operation in the table below. Include only road traffic and the A/C unit. Exclude sources such as aircraft, trains, people, animals, other mechanical equipment, etc. Then subtract the results obtained in D1 for the ambient without the A/C in operation.

A/C ON (20 minute minimum required per NPC-103 Section 4):				
LOCATION	Leq READING (dBA)	TIME		A/C ON - AMBIENT DIFFERENCE (dBA)
		START	END	
A	(A3) 54	4:10 pm	4:32 pm	54 (A3) - 44 (A1) = 10
B	(B3)			___ (B3) - ___ (B1) = ___
C	(C3)			___ (C3) - ___ (C1) = ___

Identify any sources inhibited during measurements: none

D6. SOUND LEVEL OF A/C ONLY

Select the adjustments using the differences from D4 or D5 above and the table below.

DIFFERENCE	(10) OR MORE	7 TO 9	4 TO 6	3	2	1	0
ADJUSTMENT	(0)	1	2	3	4	6	10

Enter the values below for the A/C ON from the 20 minute reading in D5 if conducted, otherwise use the average of three 15 second readings obtained in D3. Then enter the adjustment using the table above. Subtract the adjustment to obtain the value for the A/C ONLY.

LOCATION	A/C ON	ADJUSTMENT	A/C ONLY (dBA)
A	(A2 or A3) 54	- Ø	= (A4) 54
B	(B2 or B3)	-	= (B4)
C	(C2 or C3)	-	= (C4)

E. TONALITY CORRECTION

Is a correction for quality of sound necessary (from Part A2)? N Y/N
If yes, correction is +5dBA (See NPC-104)

F. SUMMARY

UNIT TYPE: central DATE INSTALLED: 1989

Enter results obtained from D6, E and D2. Then determine if an excess exists.

LOCATION	A/C ONLY	ADD TONALITY CORRECTION	ADJUSTED A/C ONLY	SUBTRACT SOUND LEVEL LIMIT	EXCESS* (dBA)
A	(A4) 54	+ ϕ	= 54	- (L1) 49	= 5
B	(B4) 51	+ ϕ	= 51	- (L2) 51	= ϕ
C	(C4)	+	=	- (L3)	=

* Subtract sound level limit from adjusted A/C ONLY. If number is negative, enter zero.

G. CONCLUSION

The Air Conditioning Condensing Unit ~~exceeds~~ / does not exceed the maximum allowable sound rating in bels.

The maximum allowable sound level limit in dBA of the Air Conditioning Condensing Unit:

[✓] is [ ] is not exceeded at Location A by 5 dBA,
[ ] is [✓] is not exceeded at Location B by ___ dBA,
[ ] is [ ] is not exceeded at Location C by ___ dBA.

References: MOE Publications NPC-103 and NPC-216.

APPENDIX C

AIR CONDITIONING DEVICE NOISE
INVESTIGATION CHECKLIST

A. GENERAL INFORMATION

DATE: _____ TIME: _____

ADDRESS OF A/C UNIT LOCATION_____

ADDRESS OF COMPLAINANT _____

INVESTIGATOR_____

1) What type of unit is installed?
[ ] Window
[ ] Wall
[ ] Central

2) Does the sound have an audible tonal characteristic or rattle? Y / N
If yes, describe_____

3) Does there seem to be a vibration? Y / N
If yes, describe _____

4) Was the owner made aware of the problem, if any? Y / N
If so how? _____

_____

5) What action is the owner willing to take in abating the problem?_____

_____

6) When was the air conditioner device installed? _____

7) Identify: Make:_____

Model:_____

Serial No.:_____

Sound Emission Limit for central units of 38,900 BTUH or less only (check with manufacturer):

[ ] Manufactured before 1991: no limit
[ ] Bel rating if manufactured in 1991: ____ bels (limit 8.0)
[ ] Bel rating if manufactured in 1992 or later: ____ bels (limit 7.6)

Does an excess exist? Y / N

B. SKETCH OF MEASUREMENT LOCATION (outdoor patio/deck or window)

PHOTOS REQUIRED TO BE TAKEN
(Attach here)

NOTE: Prepare sketch to show location of complainant's property, location of air conditioner, and any objects or structures between the air conditioner and any point of reception. All sketches must show the measured distance between points of reference. Patio/deck measurement location is 1.5 m above ground/floor. Window measurement location is middle of full open area of window.

C. SOUND MEASUREMENT DATA SHEET

INSTRUMENTATION

	Make	Model	Serial #
Sound Level Meter	_____	_____	_____
Microphone	_____	_____	_____
Calibrator	_____	_____	_____

INSTRUMENTATION CHECK

	Before	After
Calibration of Meter	_____	_____
Battery Check (%)	_____	_____

MEASUREMENT CONDITIONS

Time	_____	Temperature	_____
Wind Speed	_____	Precipitation	_____
Wind Direction	_____	Relative Humidity	_____

D. SOUND LEVELS

D1. AMBIENT MEASUREMENTS

Enter results of measurements in the table below. Note that ambient is due to road traffic only and excludes sources such as aircraft, trains, people, animals, mechanical equipment, etc.

AMBIENT WITH A/C OFF (20 minute minimum required per NPC-103 Section 4):				
LOCATION	Leq READING (dBA)	TIME		DURATION MINUTES
		START	END	
A	(A1)			
B	(B1)			
C	(C1)			

Identify any sources inhibited during measurements: _____

D2. SOUND LEVEL LIMIT

Select the applicable sound level limit from below. Use the less restrictive of the general or the specific sound level limit.

General Sound Level Limit

One hour Equivalent Sound Level of road traffic + 5 dBA measured during the period 07:00 to 21:00 hours.

Use ambient sound level obtained in D1 + 5 dBA.

LOCATION A: AMBIENT(A1) = _____ + 5 = _____ dBA
LOCATION B: AMBIENT(B1) = _____ + 5 = _____ dBA
LOCATION C: AMBIENT(C1) = _____ + 5 = _____ dBA

Specific Sound Level Limit

Check with municipality for Class rating.

a) A/C is a mandatory requirement for transportation noise control: [ ] 55 dBA

b) Moderately noisy urban area, Class 1: [ ] 50 dBA

c) Quiet urban area, Class 2: [ ] 45 dBA

Identify the less restrictive (higher) sound level limit and enter the sound level limits below.

LOCATION	LESS RESTRICTIVE LIMIT		SOUND LEVEL LIMIT (dBA)
A	[ ] general	[ ] specific	(L1)
B	[ ] general	[ ] specific	(L2)
C	[ ] general	[ ] specific	(L3)

D3. SHORT MEASUREMENT WITH A/C ON

Enter results of measurements with A/C in operation in the table below. Include only road traffic and the A/C unit. Exclude sources such as aircraft, trains, people, animals, other mechanical equipment, etc. Enter sound level limit from above and calculate difference.

A/C ON: Use average of three 15 second readings per NPC-103 Section 3 for steady sound							
		READING (dBA)					
LOCATION	TIME	1.	2.	3.	AVERAGE (dBA)	LIMIT (dBA)	DIFFERENCE (dBA)
A					(A2)	(L1)	(A2 - L1)
B					(B2)	(L2)	(B2 - L2)
C					(C2)	(L3)	(C2 - L3)

LOCATION

Is difference more than zero? A: Y/N, B: Y/N, C: Y/N

If No and if unit is not tonal, proceed to Part F and insert average values (A2, B2 or C2) for A/C only values (A4, B4 or C4). Otherwise, continue with D4 below.

D4. DIFFERENCE BETWEEN A/C ON AND AMBIENT

Determine the difference in sound level between A/C on and ambient using the table below.

LOCATION	A/C ON (dBA), FROM D3.	AMBIENT (dBA), FROM D1.	DIFFERENCE (dBA)
A	(A2)	(A1)	(A2-A1)
B	(B2)	(B1)	(B2-B1)
C	(C2)	(C1)	(C2-C1)

LOCATION

	A	B	C
Is difference between A/C ON and A/C OFF less than 10 dBA?	Y/N	Y/N	Y/N

If No, use A/C ON readings as A/C ONLY readings and continue to Part D6. [ ]A [ ] B [ ] C
If Yes, measure A/C for 20 minutes. [ ] A [ ] B [ ] C

D5. 20 MINUTE MEASUREMENT WITH A/C ON AND DIFFERENCE FROM AMBIENT

Enter results of measurements with the A/C in operation in the table below. Include only road traffic and the A/C unit. Exclude sources such as aircraft, trains, people, animals, other mechanical equipment, etc. Then subtract the results obtained in D1 for the ambient without the A/C in operation.

A/C ON (20 minute minimum required per NPC-103 Section 4):				
LOCATION	Leq READING (dBA)	TIME		A/C ON - AMBIENT DIFFERENCE (dBA)
		START	END	
A	(A3)			___ (A3) - ___ (A1) = ___
B	(B3)			___ (B3) - ___ (B1) = ___
C	(C3)			___ (C3) - ___ (C1) = ___

Identify any sources inhibited during measurements: _____

D6. SOUND LEVEL OF A/C ONLY

Select the adjustments using the differences from D4 or D5 above and the table below.

DIFFERENCE	10 OR MORE	7 TO 9	4 TO 6	3	2	1	0
ADJUSTMENT	0	1	2	3	4	6	10

Enter the values below for the A/C ON from the 20 minute reading in D5 if conducted, otherwise use the average of three 15 second readings obtained in D3. Then enter the adjustment using the table above. Subtract the adjustment to obtain the value for the A/C ONLY.

LOCATION	A/C ON	ADJUSTMENT	A/C ONLY (dBA)
A	(A2 or A3)	-	= (A4)
B	(B2 or B3)	-	= (B4)
C	(C2 or C3)	-	= (C4)

E. TONALITY CORRECTION

Is a correction for quality of sound necessary (from Part A2)? ____ Y/N
If yes, correction is +5dBA (See NPC-104)

F. SUMMARY

UNIT TYPE: _____ DATE INSTALLED: _____

Enter results obtained from D6, E and D2. Then determine if an excess exists.

LOCATION	A/C ONLY	ADD TONALITY CORRECTION	ADJUSTED A/C ONLY	SUBTRACT SOUND LEVEL LIMIT	EXCESS* (dBA)
A	(A4)	+	=	- (L1)	=
B	(B4)	+	=	- (L2)	=
C	(C4)	+	=	- (L3)	=

* Subtract sound level limit from adjusted A/C ONLY. If number is negative, enter zero.

G. CONCLUSION

The Air Conditioning Condensing Unit exceeds / does not exceed the maximum allowable sound rating in bels.

The maximum allowable sound level limit in dBA of the Air Conditioning Condensing Unit:

[ ] is [ ] is not exceeded at Location A by ___ dBA,
[ ] is [ ] is not exceeded at Location B by ___ dBA,
[ ] is [ ] is not exceeded at Location C by ___ dBA.

References: MOE Publications NPC-103 and NPC-216.